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[54] Name of Invention:

Computer-Suggested Fertilizer Composition

[57] Abstract

This invention specifies a method of using a computer to suggest a fertilizing formulation, where parameters, such as environmental conditions, are fed into a computer, then the computer selects a projected output increase rate C that complies with or approximates the input conditions, works out the next annual plan Y, identifies the tripartite fertilizer effect fitting formula that is the most approximate to the input parameters, determines the suggested proportions of nitrogen, phosphate and potash fertilizers, and displays them on the monitor based on the input parameters which are easy to establish, void of human subjective discretion, and easy of operation. This invention can scientifically determine the quantity of fertilizer and the ratio between nitrogen, phosphorus and potash in the fertilizer, thus providing substantial economic benefits.

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Claims

1. A method of using a computer to suggest a fertilizer formula, including a computer, a monitor, a keyboard and a tripartite fertilizer effect fitting formula:

$$Y = b_0 + b_1 N + b_2 N^2 + b_3 P + b_4 P^2 + b_5 K + b_6 K^2 + b_7 NP + b_8 NK + b_9 PK$$

In this formula, Y is the projected output, N, P, K are the fertilizing nitrogen, phosphorus and potash respectively; b_0 to b_9 are constants whose values are derived by the above formula from field experiments based on various environmental parameters and predetermined conditions. Typically, environmental parameters including type of soil, altitude, terrain and other parameters including last year's output, quantity of fertilizer applied, species of crop, type and quantity of fertilizers are fed to a computer by the specially designated keys on the keyboard in a manner of a man-machine dialogue. The computer first selects from a series of projected output increase rate c formulas a formula c that complies with or approximates the input parameters. The projected output increase rate c formula is as follows:

$$c = 0.3 - (a + b Y_1) \div 200 \qquad ①$$

In this formula, a and b are constants, Y_1 is last year's output.
Based on the c value derived, the computer then works out the next year's projected output Y by the following formula:

$$Y = (1 + c) Y_1 \qquad ②$$

The computer works out Y, then compares Y with a series of tripartite fertilizer effect fitting formulas in its storage against the various input parameters, selects the formula most approximate to the input parameters, works out the nitrogen-phosphate-potash fertilizing formulations by the tripartite fertilizer effect fitting formula with the imported Y value that has just been formulated, and displays the suggested fertilizing formulation on the monitor.

2. With the method of using computer to suggest a fertilizing formulation as described in Claim 1, the constants a and b in Formula ① are worked out by experiments and the following formula:

$$y = x \div (a + b x) \qquad ②$$

In this formula, y is the output from fully fertilized area, x is that from unfertilized area. A series of projected output increase rate c formulas are derived by substitutions of Formula ① with a series of constants a and b, which have been obtained with Formula ② and experiments under various conditions.

3. With the method of using a computer to suggest a fertilizing formulation as described in Claim 1, the projected output increase rate c value of Guizhou Province corn crop is calculated by the following formula:

$$c = 0.5 - (23.27 + 0.13 Y_1) \div 200$$

In this formula, Y_1 is last year's output.

Specification

Method of Using a Computer to Suggest a Fertilizer Composition

This invention is concerned with a method to use a computer to suggest a fertilizer composition. It falls within the domain of fertilizing techniques.

Up to now, in the field of agricultural fertilizing techniques, the widely used method for fertilization is that of nutrients equilibrium computation. However, with the method of nutrients equilibrium computation, one still has to pinpoint the quantity of fertilizer needed by the crop, the output coefficient of the fertilizer, the contents of effective nutrients in the fertilizer, the manure contents in the soil, the projected output target, and other important parameters, whose values are all very difficult to determine in practice. On top of that, there is another Patent Application numbered 86108727.5 and entitled The Identification of Soil Type and Method of Optimal Fertilization, which publishes a fertilizing method, requiring that the producer furnish an expectation value, e.g. the quantity of fertilizer under a fixed output, the output value under a fixed quantity of fertilizer, or the economical quantity of fertilizer under a fixed amount of production capital, etc. The provision of these expectation values often depends on the producer's subjective discretion. Therefore, this fertilizing method is not good enough.

This invention is aimed at providing a method of basing output on land and composing by functions, i.e. a method of computer-suggested fertilizer composition that compares and selects for optimum from among the known parameters such as last year's output and its conditions, and also such data as to derive from numerous field experiments and practices, so as to identify the most appropriate functions to compose a fertilizing formulation.

The realization of the aim includes: a computer, a monitor, a keyboard, and the following tripartite fertilizer effect fitting formula:

$$Y = b_0 + b_1 N + b_2 N^2 + b_3 P + b_4 P^2 + b_5 K + b_6 K^2 + b_7 NP + b_8 NK + b_9 PK$$

In this formula, Y is the projected output, N, P, K are the fertilizing nitrogen, phosphorus and potash respectively; b_0 to b_9 are constants whose values are derived by the above formula from field experiments based on various environmental parameters and pre-set conditions, i.e. environmental parameters including type of soil, altitude, terrain and other parameters including last year's output, quantity of fertilizer applied, species of crop, type and quantity of fertilizers are fed to a computer by the specially designated keys on the keyboard in a manner of man-machine dialogue. The computer first selects from a series of the formulas for the projected output increase rate c, a formula c that complies with or approximates the input parameters. The formula for the projected output increase rate c is as follows:

$$c = 0.5 - (a \div b Y_1) \div 200 \qquad ①$$

In this formula, a and b are constants, Y_1 is last year's output.
Based on the c value derived, the computer then works out the next year's projected output Y by the following formula:

$$Y = (1 + c) Y_1 \qquad ②$$

The computer works out Y, then compares Y with a series of tripartite fertilizer effect fitting formulas in its storage against the various input parameters, selects the formula, which most approximates the input parameters, works out the nitrogen-phosphate-potash fertilizing formulation by the tripartite fertilizer effect fitting formula with the imported Y value that has just been formulated, and displays the suggested fertilizing formulation on the monitor. The constants a and b in Formula ① are worked out by experiments and the following formula:

$$y = x \div (a \div b x) \qquad ③$$

In this formula, y is the output from fully fertilized area, x is that from unfertilized area. A series of formulas for the projected output increase rate c derived by substitutions of Formula ① with a series of constants a and b, which have been obtained with Formula ③

and experiments under various conditions.

Compared to the existing technologies, the input parameters required with this invention are easy to establish, void of human subjective discretion as the formulas for the projected output value and the fertilizing formulation are based on numerous field experiments and practices. It is also easy to operate. The operator who does the fertilization on the suggested formulation can scientifically determine the quantity of fertilizer and the ratio between nitrogen, phosphorus and potash in the fertilizer, thus gaining substantial economic benefits.

The following are some cases of implementation to further clarify the descriptions:
In this case, a PC-1500 computer is used with compatible monitor and keyboard, together with the following tripartite fertilizer effect fitting formula:

$$Y = b_0 + b_1 N - b_2 N^2 + b_3 P + b_4 P^2 + b_5 K + b_6 K^2 - b_7 N P + b_8 N K - b_9 P K$$

In this formula, Y is the projected output, N, P, K are the fertilizing nitrogen, phosphorus and potash respectively; b_0 to b_9 are constants whose values are derived by the above formula from field experiments based on various environmental parameters and pre-set conditions, e.g. the tripartite fertilizer effect fitting formula adopts the following forms for the corn crops in some areas in Guizhou Province:

(1) HongFengHu Town, QingZhen County, Guizhou Province: gradient 0, terrain basin, altitude 1242 meters, soil type yellow muddy, crop corn, corn type Qianxi No. 4, so that its tripartite fertilizer effect fitting formula is:

$$Y = 260.72 + 5.313 N - 0.0414 N^2 + 1.595 P - 0.0042 P^2 + 4.102 K - 0.129 K^2 - 0.147 N P + 0.0339 N K - 0.0946 P K$$

(2) LongCang Town, FuQuan County, Guizhou Province: terrain hillside, gradient 5°, altitude 1100 meters, soil type yellow muddy, crop corn, corn type local, so that its tripartite fertilizer effect fitting formula is:

$$Y = 284.11 + 3.044\ N - 0.052\ N^2 + 4.018\ P - 0.184\ P^2 - 2.72K - 0.085\ K^2 + 0.112\ N\ P - 0.033\ N\ K + 0.047\ P\ K$$

(3) MinHe Village, JiangKou County, Guizhou Province: terrain hillside, gradient 10°, altitude 680 meters, soil type yellow muddy, crop corn, corn type meso-single-hybrid, so that its tripartite fertilizer effect fitting formula is:

$$Y = 211.7 + 29.14\ N - 1.06N^2 - 71.72\ P - 4.00P^2 + 40.9K - 2.07K^2 + 5.33N\ P - 4.85N\ K + 8.43P\ K$$

(4) JiaBa Village, SiNan County, Guizhou Province: terrain basin, gradient 0°, altitude 585 meters, soil type muddy bean-like surface, crop corn, corn type meso-single-hybrid, so that its tripartite fertilizer effect fitting formula is:

$$Y = 329.48 - 4.74N - 0.189\ N^2 + 8.524\ P - 0.559\ P^2 + 9.755\ K - 1.199\ K^2 + 0.452\ N\ P + 1.212\ N\ K - 0.179\ P\ K$$

(5) XingBao Village, DaoZhen County, Guizhou Province: terrain hillside, gradient 5°, altitude 900 meters, soil type very muddy, crop corn, corn type 73 single hybrid, so that its tripartite fertilizer effect fitting formula is:

$$Y = 255.33 + 10.86\ N - 0.318\ N^2 - 19.84\ P - 1.453\ P^2 + 18.916K - 1.043\ K^2 + 1.824\ N\ P - 1.658\ N\ K - 2.575\ P\ K$$

Environmental parameters including type of soil, altitude, terrain and other parameters including last year's output, quantity of fertilizer applied, species of crop, type and quantity of fertilizers, etc. are fed to a computer by the specially designated keys on the keyboard in a manner of man-machine dialogue. The computer first selects from a series of projected for formulas for output increase rate c a formula that complies with or approximates the

input parameters. The projected output increase rate c formula is as follows:

$$c = 0.5 - (a \div b Y_1) \div 200 \qquad ①$$

In this formula, a and b are constants, Y_1 is last year's output.
Based on the c value derived, the computer then works out the next year's projected output Y by the following formula:

$$Y = (1 + c) Y_1 \qquad ②$$

The computer works out Y, then compares Y with a series of tripartite fertilizer effect fitting formulas in its storage against the various input parameters, selects the formula most approximate to the input parameters, works out the nitrogen-phosphate-potash fertilizing formulation by the tripartite fertilizer effect fitting formula with the imported Y value that has just been formulated, and displays the suggested fertilizing formulation on the monitor. The constants a and b in Formula ① are worked out by experiments and the following formula:

$$y = x \div (a \div b x) \qquad ③$$

In this formula, y is the output from fully fertilized area, x is that from unfertilized area. A series of projected output increase rate c formulas are derived by substitutions of Formula ① with a series of constants a and b, which have been worked out with Formula ③ and experiments under various conditions. For example, the projected corn crop output increase rate c value of Guizhou Province is worked out by the following formula:

$$c = 0.5 - (23.27 \div 0.13 Y_1) \div 200$$

According to the statistics collected from the comparative experiments in 114 major districts in 30 counties of Guizhou Province, fertilization with the formulations suggested with this invention contributes to a one-time average output of 373.3 kilograms per mu* of corn land, or 65 kilograms higher than that by farmers with conventional fertilization methods.

Translator's note: mu = In the market system (shì zhì 市制) as applied to agricultural land, = 666 2/3 square meters (UN, *1966*).

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Translation

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[54]发明名称 采用计算机推荐施肥配方的方法

[57]摘要

本发明提供了一种采用计算机推荐施肥配方的方法，它将环境条件等参数输入到计算机里，计算机根据输入的参数首先选出符合或近似输入参数条件的计划增产率C，计算出下年计划Y，找出最接近输入参数的三元素肥料效应方程拟合式，计算出推荐的氮、磷、钾施肥配方，并将其在显示器上显示出来。本发明输入的参数容易确定，避免了人为的主观随意性，操作容易，能够科学地确定施肥量和肥料中的氮、钾、磷比例，所取得的经济效益比较明显。

权 利 要 求 书

1、一种采用计算机推荐施肥配方的方法，它包括计算机、显示器、键盘和三元素肥料效应方程拟合式：

$$Y = b_0 + b_1 N + b_2 N^2 + b_3 P + b_4 P^2 + b_5 K + b_6 K^2 + b_7 NP + b_8 NK + b_9 PK$$

式中Y为计划产量，N、P、K为肥料中的氮、磷、钾；b_0～b_9为常数，其值是根据各种不同的环境参数和设定的条件由田间实验法上式求出，其特征是：将土壤类型、海拔高度、地形等环境参数以及上年产量、施肥量、农作物品种、肥料种类和数量等参数通过键盘上专门指定的按键按人机对话的方式输入到计算机里，计算机根据输入的参数首先从存储器里的一系列计划增产率c的公式中选出符合或近似输入参数条件的计划增产率c的公式，计划增产率c的公式形式为：

$$c = 0.5 - (a + b Y_1) \div 200 \qquad ①$$

上式中的a、b为常数，Y_1为上年产量；

根据求出的c值，再按下式计算出下年的计划产量Y：

$$Y = (1 + c) Y_1 \qquad ②$$

在计算出Y后，计算机再根据输入的各种参数与存储器中的一系列三元素肥料效应方程拟合式进行比较，找出最接近输入参数条件的三元素肥料效应方程拟合式，并将已求出的计划产量Y值带入该三元素肥料效应方程拟合式计算出推荐的氮、磷、钾施肥配方，然后将该推荐的施肥配方输出到显示器上显示出来。

2、按照权利要求1所述的这种采用计算机推荐施肥配方的方法，其特征在于：公式①中的常数a、b是由下式：

$$y = x \div (a + b x) \qquad ③$$

和试验求出，式中y为完全施肥区产量，x为不施肥区产量；将通过公式③和试验求出的在各种不同条件下的一系列a、b常数值代入公式①就得到了一系列计划增产率c的公式。

3、按照权利要求1所述的这种采用计算机推荐施肥配方的方法，其特征在于：贵州省玉米农作物的计划增产率r值由下式确定：

$$r = 0.5 - (23.27 \div 0.13Y_1) \div 200$$

式中Y1为上年产量。

说 明 书

采用计算机推荐施肥配方的方法

本发明涉及一种采用计算机推荐施肥配方的方法，属于施肥技术领域。

目前，在农业施肥技术中广泛采用养分平衡计量施肥原理的方法来进行施肥，但是由于养分平衡计量施肥原理需要准确确定农作物的需肥量、肥料利用率、肥料中的有效养分含量、土壤供肥量、计划产量指标等重要参数，在实践中要确定这些参数值是很困难的。另外在专利申请号为86108727.5、发明名称为土壤识别与优化施肥方法的专利申请公开说明书中，公开了一种施肥方法，该方法要求生产者提供出期望值，即在一定产量值下的施肥量、或一定施肥量下的产量值、或在确定生产资金下的经济施肥量等，这种提供期望值的方法往往取决于生产者的主观随意性，因此这种施肥方法还是不够理想。

本发明的目的是提供一种采用以地定产、函数配方的方法，并运用计算机将生产者提供的上年产量及运用范围的已知参数与大量田间试验、实践得出的数据进行比较、优选，找出最符合实际的函数进行施肥配方的计算机推荐施肥配方的方法。

本发明的目的是这样实现的：它包括计算机、显示器、键盘和三元素肥料效应方程拟合式：

$$Y = b_0 + b_1 N + b_2 N^2 + b_3 P + b_4 P^2 + b_5 K + b_6 K^2 + b_7 NP + b_8 NK + b_9 PK$$

式中Y为计划产量，N、P、K为肥料中的氮、磷、钾；b_0～b_9为常数，其值是根据各种不同的环境参数和设定的条件由田间实验按上式求出；将土壤类型、海拔高度、地形等环境参数以及上年产量、施肥量、农作物品种、肥料种类和数量等参数通过键盘上专门指定的按键按人机对话的方式输入到计算机里，计算

机根据输入的参数首先从存储器里的一系列计划增产率 c 的公式中选出符合或近似输入参数条件的计划增产率 c 的公式，计划增产率 c 的公式形式为：

$$c = 0.5 - (a + b Y_1) \div 200 \qquad ①$$

上式中的 a 、 b 为常数， Y_1 为上年产量；

根据求出的 c 值，再按下式计算出下年的计划产量 Y ：

$$Y = (1 + c) Y_1 \qquad ②$$

在计算出 Y 后，计算机再根据输入的各种参数与存储器中的一系列三元素肥料效应方程拟合式进行比较，找出最接近输入参数条件的三元素肥料效应方程拟合式，并将已求出的计划产量 Y 值带入该三元素肥料效应方程拟合式计算出推荐的氮、磷、钾施肥配方，然后将该推荐的施肥配方输出到显示器上显示出来。公式①中的常数 a 、 b 是由下式：

$$y = x \div (a + b x) \qquad ③$$

和试验求出，式中 y 为完全施肥区产量， x 为不施肥区产量；将通过公式③和试验求出的在各种不同条件下的一系列 a 、 b 常数值代入公式①就得到了一系列计划增产率 c 的公式。

与现有技术相比，本发明所需输入的参数容易确定，并且求计划产量值及施肥配方的公式是建立在大量的田间试验及实践的基础上，完全避免了人为的主观随意性；而且本发明操作容易、操作者按推荐的配方施肥，能够科学地确定施肥量和肥料中的氮、磷、钾比例，所取得的经济效益比较明显。

下面进一步说明本发明的实施例：

在本实施例中计算机采用 P C － 1500型计算机，显示器、键盘与其计算机型号相配套就可，三元素肥料效应方程拟合式：

$$Y = b_0 + b_1 N + b_2 N^2 + b_3 P + b_4 P^2 + b_5 K + b_6 K^2 + b_7 N P + b_8 N K + b_9 P K$$

式中 Y 为计划产量， N 、 P 、 K 为肥料中的氮、磷、钾； b_0 ～ b_9 为常数，其值是根据各种不同的环境参数和设定的条件由田

阿实验按上式求出；例如贵州省几个地区的玉米农作物三元素肥料效应方程拟合式的公式形式如下：

(1) 贵州省晴镇县红岩湖镇，坡度0、盆地、海拔高度为1242米、土壤类型为黄泥土、农作物为玉米、玉米品种为黔西4号，其三元素肥料效应方程拟合式为：

$$Y = 260.72 + 5.313\ N - 0.0414N^2 + 1.595\ P - 0.0042P^2 + 4.102\ K - 0.129\ K^2 - 0.147\ NP + 0.0339NK + 0.0946PK$$

(2) 贵州省福泉县龙昌镇，地形为山地、坡度5°、海拔高度为1100米、土壤类型为黄泥土、农作物为玉米、玉米品种为本地品种，其三元素肥料效应方程拟合式为：

$$Y = 264.11 + 3.044\ N - 0.052\ N^2 + 4.019\ P - 0.184\ P^2 + 2.72K - 0.085\ K^2 + 0.112\ NP - 0.033\ NK + 0.047\ PK$$

(3) 贵州省江口县民和乡，地形为山地、坡度10°、海拔高度为680米、土壤类型为黄泥土、农作物为玉米、玉米品种为中单杂交种，其三元素肥料效应方程拟合式为：

$$Y = 211.7 + 29.14\ N - 1.06N^2 - 71.72\ P - 4.00P^2 + 40.9K - 2.07K^2 + 5.33NP - 4.85NK + 8.43PK$$

(4) 贵州省思南县家坝乡，地形为盆地、坡度0°、海拔高度为585米、土壤类型为豆面泥土、农作物为玉米、玉米品种为中单杂交种，其三元素肥料效应方程拟合式为：

$$Y = 329.48 - 4.74N - 0.189\ N^2 + 8.524\ P - 0.569\ P^2 + 9.755\ K - 1.199\ K^2 + 0.452\ NP + 1.212\ NK - 0.179\ PK$$

(5) 贵州省道真县兴宝乡，地形为山地、坡度5°、海拔高度为900米、土壤类型为大土泥土、农作物为玉米、玉米品种为73单杂交种，其三元素肥料效应方程拟合式为：

$$Y = 255.33 + 10.86\ N - 0.318\ N^2 - 19.64\ P - 1.453\ P^2 + 18.916K - 1.043\ K^2 - 1.824\ NP - 1.658\ NK - 2.575\ PK$$

将土壤类型、海拔高度、地形等环境参数以及上年产量、施肥量、农作物品种、肥料种类和数量等参数通过键盘上专门指定的按键按人机对话的方式输入到计算机里，计算机根据输入的参数首先从存储器里的一系列计划增产率 c 的公式中选出符合或近似输入参数条件的计划增产率 c 的公式，其公式形式为：

$$c = 0.5 - (a \div b Y_1) \div 200 \qquad ①$$

上式中的 a、b 为常数，Y_1 为上年产量；

根据求出的 c 值，再按下式计算出下年的计划产量 Y：

$$Y = (1 + c) Y_1 \qquad ②$$

在计算出 Y 后，计算机再根据输入的各种参数与存储器中的一系列三元素肥料效应方程拟合式进行比较，找出最接近输入参数条件的三元素肥料效应方程拟合式，并将已求出的计划产量 Y 值带入该三元素肥料效应方程拟合式计算出推荐的氮、磷、钾施肥配方，然后将该推荐的施肥配方输出到显示器上显示出来。公式①中的常数 a、b 是由下式：

$$y = x \div (a + b x) \qquad ③$$

和试验求出，式中 y 为完全施肥区产量，x 为不施肥区产量；将通过公式③和试验求出的在各种不同条件下的一系列 a、b 常数值代入公式①就得到了一系列计划增产率 c 的公式。例如贵州省的玉米农作物计划增产率 c 的公式为：

$$c = 0.5 - (23.27 \div 0.13 Y_1) \div 200$$

通过在贵州省30个县114 个大区作对比试验统计，运用本发明所推荐的配方进行施肥，其平均每亩玉米单产为373.3 公斤，比农民按习惯施肥平均每亩增产65公斤。